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Reports on achievements in surveying, mapping and charting in addressing national, subregional, regional and global issues: technical issues

The importance of geographic names in spatial data infrastructure**

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INTRODUCTION

Place names are perhaps the most commonly and widely used form of geospatial information, consisting of official and local names of administrative, cultural and geographic features, including streets and roads. Each individual toponym (name), constitutes a relatively simple datum, but with growing community demands, and sophisticated advances in technology, place names are now required to meet many levels of service expectation, where the currency of data is of key importance.

Foremost is the demand for real time data, in the protection of life and property by emergency service organisations. At a more general level, current data on location and extent is required by a wide range of administrative and planning agencies, such as statistics for population and census planning and development programs. At another level again, there is a growing demand for, and expectation of, access to the historical data inherent in the record of successively assigned place names and their "meaning".

The role of geographic names is superficially, pretty self evident. Though there are aspects of the need to regulate/standardise the use, collection, and registration of place names for official purposes which are not so readily apparent. I will discuss these in the course of this paper.

In some parts of the world Regional Spatial Data Infrastructures (RSDI) are being developed, for example, the Asia-Pacific Spatial Data Infrastructure (APSDI) proposed by the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) has the following objectives (as set out in Article 5 of the Statutes) which it is endeavouring to achieve:

a. To define the nature of a regional geographic information infrastructure that each country in the region can contribute to in order to meet regional and global mapping and GIS requirements.

b. To determine the nature of legislative and administrative procedures and orders appropriate to the acquisition and sharing of spatial data.

c. To develop a regional geodetic framework, regional topographic datasets, national cadastral datasets and regional **geographical names** datasets as the basis for regional GIS activity.

d. To document the status of key geographic datasets and key agencies in each member nation, and develop a framework for the exchange of such information.

e. To prepare guidelines and strategies to assist member nations for the implementation of cadastral development to meet individual member nation needs.

f. To determine the need for research, training and technology and policy exchange in relation to the beneficial impact of geographic information on the social, economic and environmental objectives of member nations of Asia and the Pacific region.

g. To explore opportunities for aid funding to support development needs of member nations and for the development of a regional spatial data infrastructure.

I propose to outline the role I believe geographic place names will play, as a fundamental data set within a RSDI.

GEOGRAPHIC PLACE NAMES

The naming of places and geographic features is a very human activity, springing in the first instance from a need to know and relate to landscape. The mass movements of peoples, in the last several centuries, and nostalgia for "home" places, has uniquely marked the geography and history of the landscape.

There are two main areas in which the community as a whole, has an interest in the naming of places:

1. Ensuring the capacity to unambiguously identify and locate geographical entities and places, as an essential reference system for services, infrastructure and public administration.

2. Ensuring that the valuable record of a country's place names, with its variety of sources, reflecting unique patterns of settlement is preserved and accessible.

Given these public interest objectives, governments in many countries have established Geographic Names Authorities, whose central role is to authorise place names for official purposes and to issue policy guidelines on standard usage, and written form and spelling.

Government's primary role in standardisation and registration is to promote effective, useable place names, to provide unambiguous direction. While this is obvious, there are many ways in which clear identification and unambiguous use are compromised.

- Many places have more than one name
- Many names are duplicated even in local areas
- Names may have variant spelling
- Local names may be different to the more widely recognised international names
- Names in some countries can be written in non-Roman script.

I will discuss the role of the United Nations Group of Experts on Geographical Names (UNGEGN), later in the paper.

A secondary purpose, shared by a range of interested groups and organisations – is the collection and preservation of place and feature names, and their variants over time, as they retain much of our culture memory and heritage. Place names are often an important contributor to historical information.

REGIONAL SPATIAL DATA INFRASTRUCTURE

Geospatial Information (GI), has been collected and managed mainly in the form of maps and text, the advent of digital data has created a "sea-change" in the way we think about and want to use GI. These new possibilities are the impetus behind the conceptualisation and development of a system of integrated data sets, which are independent of, and integrate the data of the separate administrative and political jurisdictions of a country or a region.

It is important to note that micro-economic reforms and structural adjustment, such as competition policy, streamlining government business and focussing on core roles of government, have reinforced for all governments the need to develop a single integrated, easily accessible land information infrastructure. Many of the key land information projects in the planning or early implementation stage at the moment, require levels of investment, which emphasise the need for all jurisdictions to operate nationally and regionally to meet national and regional needs. Only a national system, a national market can maximise the investment required in data collection and maintenance.

The PCGIAP's vision for the Asia-Pacific Spatial Data Infrastructure (APSDI) is of a network of databases, located throughout the region, that together provide the fundamental data needed to achieve the region's economic, social, human resources development and environmental objectives.

Those distributed databases include geodetic, topographic, hydrographic, geographic names, administrative and environmental data. They may, in the future, be linked electronically so that they appear, to the user, as a virtual database, but they will also be linked together in a number of other important ways:

- they will be linked by an intra-regional institutional framework that provides mechanisms for sharing experience, technology transfer and coordination of the development of the regional fundamental datasets.
- they will be linked by the use of common technical standards, including a common geodetic reference frame, so that data from numerous databases can be brought together to create new products and solve new problems, both regionally and globally;
- they will be linked by the adoption of common policies on data access, pricing, privacy, confidentiality and custodianships, they will be linked by the implementation of inter-governmental agreements on data sharing,
- they will be linked through a comprehensive and freely accessible directory of available datasets containing descriptions and administrative information that accords with agreed standards for meta data;

It is this suite of administrative and technical linkages that distinguishes a RSDI from a collection of uncoordinated datasets, which will make it such a powerful tool for the region's economic and social development.

Many of the things that nations of a region want to achieve together can only be achieved if good, consistent spatial data is available and readily accessible. This is especially important when planning for the future.

Geographic (or spatial) data describes information that can be related to a position on the earth's surface whether that be on the land, sea or in the air. Information about geographic names, vegetation, minerals, road networks, property ownership, soils, air quality and population distribution can all be spatially related. Regional issues such as catchment management, land development and transport planning all require good, consistent spatial information. There are few areas of cooperation between nations which do not rely either directly or indirectly on this kind of information.

I am sure this conference believes that resources should not be wasted on duplicated effort. I am confident that the Permanent Committee for the Americas also believes that the nations of the region should reach agreement on what fundamental datasets are required to meet their common interests, to what standards they should be collected and maintained, which agencies should have custodianship of those data, and what the priorities are for their collection.

A RSDI can provide the institutional and technical framework to ensure the required consistency, content and coverage to meet regional needs. The infrastructure also ensures that national efforts are focussed and coordinated, thereby maximising investment in data collection and maintenance from a regional perspective. Finally, such an infrastructure will help achieve better outcomes for the region through better support for economic, social and environmental decision making.

In the Asia Pacific area the Permanent Committee on GIS Infrastructure for Asia and the Pacific has developed a spatial data infrastructure model that comprises four core components – institutional framework, technical standards, fundamental datasets, and access networks. These core components are linked as follows:

Institutional Framework

Defines the policy and administrative arrangements for building, maintaining, accessing and applying the standards and datasets.

Technical Standards

Define the technical characteristics of the fundamental datasets and enable them to be integrated with other environmental, social and economic datasets.

Fundamental Datasets

Are produced within the institutional framework and fully comply with the technical standards.

Access Network

Is the means by which the regional fundamental datasets are made accessible to the community, in accordance with policy determined within the institutional framework, and to the technical standards agreed.

The essential component of a RSDI is the Fundamental Datasets which are produced within the Institutional Framework and are collected as primary data sources, from which other data and information are derived by integration or value-adding. A fundamental dataset is defined as follows -

> A fundamental dataset, in the context of a Regional Spatial Data Infrastructure, is a dataset for which there is a demand for consistent regional coverage. This demand for a consistent coverage implies that:
>
> - there is a need for coordination between custodians to ensure that components of that region datasets are collected to consistent standards,
> - the community of users must be adequately consulted to determine specifications and priorities,
> - access to the data is provided in accordance with policies determined for a Regional Spatial Data Infrastructure, and
> - the regional datasets conforms with a set of standards that ensures that it can be combined with other components of a Regional Spatial Data Infrastructure to create value added products.

There are three principal issues associated with the provision of regional fundamental datasets:

- identification and prioritisation,
- production and integration, and
- data maintenance.

I believe names is a fundamental data set for any Region.

UNITED NATIONS GROUP OF EXPERTS ON GEOGRAPHICAL NAMES (UNGEGN)

Consistent use of accurate place names is an essential element of effective communication worldwide and supports social-economic development, conservation and national infrastructure. That is why the United Nations establish a Group of Experts on Geographical Names.

UNGEGN is one of the seven standing expert bodies of the United Nations Economic and Social Council (ECOSOC). It was established in 1959, to promote the standardisation of place/feature names at both the national and international levels and is, by virtue of its composition and status, the most authoritative body dealing with geographic names. The outcomes of the work undertaken, are the resolutions adopted at UN Conferences and when implemented they ensure products and data which comply with the highest international standards.

UNGEGN acts as collegiate, consultative body and agreement is reached by consensus, decisions are recommendatory in character, and do not compromise national sovereignty as international standardisation is carried out on the basis of national standardisation. UNGEGN members bring to these issues the foremost

developments in the science of language treatment and state of the art digital information management.

UNGEGN functions to develop procedures and mechanisms for standardisation in response to national needs, to develop programs of training, and particularly to assist countries which have not developed systems for the maintenance of consistent place names. Members address the outcomes and resolutions of previous United Nations Conferences on the Standardization of Geographical Names and undertake preparatory work for future international conferences and sessions of the Group of Experts.

The UN Conference promotes a formal naming process because of its importance in areas such as environmental management, sustainable development, search and rescue, peacekeeping and international aid operations, cartography, communication and overall economic development and social welfare.

The application and spelling of names of cities, villages, land and water features must be clear, current, accurate, and unambiguous. Effective communication depends on appropriate use of these names on maps, in the media and in legal documents. Inaccuracy and misrepresentation can lead to inefficiency and loss of life.

A brochure recently produced by UNGEGN sets out how everyone benefits from a consistent naming process and some of the programmes it is involved in.

To support the work of UNGEGN and to provide a closer interface to nations, UNGEGN has a number of linguistic and geographical divisions. Within the Americas area are a number of divisions including the Asia South-East and Pacific South-West Division, Latin American Division and United States of America-Canada Division.

GEOGRAPHIC NAMES AND A REGIONAL SPATIAL DATA INFRASTRUCTURE

To inter-relate geographic names, the work of UNGEGN, its Divisions and a Regional Spatial Data Infrastructure (RSDI) the four core components of the Asia Pacific Spatial Data Infrastructure will be used.

Institutional Framework

An opportunity exists for the Permanent Committee through its working groups or sub-committees to take a leadership role in supporting and encouraging nations to develop a consistent or standardised approach to geographical naming. The Permanent Committee (PC) could act as sponsor of the geographical names dataset in conjunction with the UNGEGN Divisions to ensure that a names data set for the region is assembled, maintained, delivered and accessible in a consistent way. The institutional framework of UNGEGN and its Divisions would be able to support such *initiatives*. *An important role* of UNGEGN is to provide or encourage training for countries wishing to form national name authorities or to create a place names register.

Technical Standards

The UNGEGN encourages all nations to develop toponymic guidelines for their country which not only supports standardisation within the country, but also allows other nations to understand the standardisation approach taken. Appendix 1 provides an outline of the key elements that should be considered in such guidelines.

Other key technical areas that UNGEGN undertakes a role in, is, supporting the development of single romanization systems, the development and promotion of standardised terminology in connection with place names and promoting the development of national automated data processing capabilities and international technology exchange.

The PC and this conference has the opportunity to assist UNGEGN in this work by encouraging nations to develop toponymic guidelines and national gazetteers that allow the formation of an Regional gazetteer/dataset if required.

Fundamental Datasets

As noted above, geographic names is a fundamental dataset. The PC can support and encourage nations to establish an authority in each country for national names standardisation, with the resultant names register, providing the basis for a geographic names dataset for the region. It can draw attention to duplication of names or where more than one name exists for the same place. To assist in the preparation of this dataset it can encourage collaboration between countries on the standardisation of names for trans boundary features.

Access Network

Dissemination of standardised names is a key element of any naming process, not only in promoting the application of such names on maps and in documents but also in developing access to the national gazetteers through publication or through on-line processes. The PC can play a positive role in working with nations within the region to facilitate the development of a technological framework that will provide the communities within the region access to this fundamental dataset.

OTHER GLOBAL PROGRAMS

All of the above, needs to be considered in light of the global programs that exist, whether they be UNGEGN related, other Regional initiatives or such programs as the Global Map or the Global Spatial Data Infrastructure.

CONCLUSION

As a fundamental data set of a RSDI, it is of the utmost importance to develop appropriate relationships and processes between the critical providers of data at national level, and the data base custodians who determine technical standards for data, and protocols and procedures for the entry, accessing and use of data. It will be imperative, that these relationships are collaborative and driven by the needs and

preferences of users and beneficiaries of the data, not by technical imperatives or primarily by the unilateral actions of data base custodians

There is the opportunity for the PC and this conference to support the work of UNGEGN throughout the Region with the ultimate result of achieving a fundamental data set for a Regional Spatial Data Infrastructure

Geographic names are a vitally important part of geospatial information, and not in a technical sense alone. If you can, imagine for a moment, a world without 'names' for places or landscape features, it would be a very colourless world, and if you'll pardon the pun a 'flat' world indeed, and no doubt impossible to get around in. If it is, hard to envisage, it is because, as well as serving to identify location, and communication direction, place names also express tangibly the human activity of investing the landscape with meaning and memory.

REFERENCES

- World Cartography, Volume XVIII, United Nations, New York 1986

  I Guidelines for establishing a national geographical names authority and planning a standardization programme
  II Progress and developments in standardizing geographical names within the framework of the United Nations
  III Resolutions of the United Nations Conferences on the Standardization of Geographical Names pertaining to the romanization of geographical names derived from non-Roman writing systems
  IV Social and Economic Benefits of the standardization of geographical names
  V Terms used in the standardization of geographical names
  VI Exonyms
  VII Toponymic guidelines for maps and other editors: Austria
  VIII The Pilot Training Course in Toponymy in Indonesia
  IX Geographic names information systems: philosophy and function

- World Cartography, Volume XXI United Nations 1990

  II Organisation and functions of a National Geographical Names Standardization Program: A Manual

- Asia-Pacific Spatial Data Infrastructure, Permanent Committee on GIS Infrastructure for Asia and the Pacific, Publication No. 1. PCGIAP Secretariat, 1998

- Geographic Place Names and the Australian Spatial Data Infrastructure, John Parker, Mapping Sciences Institute Proceedings, Perth, May 1998

- Consistent Use of Place Names, Brochure, UNGEGN, September 1999 (http://www.un.org/Depts/Cartographic/english/htmain.htm)

- United Nations Documents on Geographical Names, UNGEGN. Edited by Peter E. Rapier, Cause, Pretoria, 1996

INTERNET – REFERENCE SITES

Geographic Names

Australia - http://www.anzlic.org.au/icsm/cgnamain.htm
Canada - http://GeoNames.NRCan.gc.ca/english/cgcgn.html
USA - http://mapping.usgs.gov/www/gnis/bgn.html
Victoria - http://www.vicnames.vic.gov.au
(Australia)

Spatial Data Infrastructure

Asia-Pacific - http://www.permicom.apgeo.gov.au

Appendix 1: **Toponymic Guidelines.**
As originally proposed by Dr. Josef Breu in his Circular No. 2, 12 December 1977, with additions, modifications and new numbering of 1981 (Circular Letter No. 20). The title reflects modifications from the Eighth Session of UNGEGN, 1979 and from the Fourth Conference, 1982. Item 6 follows a resolution of the Fifth Conference, 1987.

Toponymic Guidelines for Map and Other Editors, for International Use
Name of individual country

1 Languages
- 1.1 General remarks
- 1.2 National language(s)
  - 1.2.1 Legal situation and practical application in administration and official cartography
  - 1.2.2 Alphabet(s) and transcription(s)
  - 1.2.3 General spelling rules for geographical names
  - 1.2.4 Pronunciation
  - 1.2.5 Grammatical peculiarities which are essential for the treatment and understanding of geographical names
  - 1.2.6 Distribution of main dialects and their characteristics; how far are dialectal name forms adapted to the standard form of the language(s)? (In the case of many African countries with English, French, Portuguese or Spanish as official languages: Distribution of main vernaculars and their characteristics; how far are vernacular name forms adapted to the spelling of the official language?). linguistic maps
- 1.3 Minority languages
  - 1.3.1 - 1.3.6, as under 1.2

2 Names authorities and names standardization
- 2.1 National names authority. Aims, functions, rules, address
- 2.2 Provincial names authorities. Aims, functions, rules, addresses
- 2.3 Names standardization. Legal aspects, procedures, progress.

3 Source Material
- 3.1 Maps: map series containing standardized names. Which sheets of a series contain already standardized names?
- 3.2 Gazetteers containing standardized names.

4 Glossary of appellatives, adjectives and other words necessary for the understanding of maps (As such glossaries will serve the needs of foreign users they must contain also – and above all – words of the general vocabulary.)

5 Abbreviations used on official maps, the decoding and meanings.

6 Methods of differentiating toponyms from other text on national maps.

Annex: Administrative maps.

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Reports on achievements in surveying, mapping and charting in addressing national, subregional, regional and global issues, including policy and institutional issues

The South American Geocentric Reference System and the Geodetic Network for the Americas

Paper submitted by the South American Geocentric Reference System**

* E/CONF.93/1.

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ABSTRACT

The South American Geocentric Reference System (*Sistema de Referência Geocêntrico para a América do Sul - SIRGAS*) project is presented, including its background, project goals, objectives, and structure. Since its establishment, in October 1993, the two working groups ("Reference System" and "Geocentric Datum") have carried out all of the tasks towards defining a new geocentric reference system and an associated datum for South America. The first project objectives were achieved on schedule in 1997 and the final report was presented at the International Association of Geodesy (IAG) Scientific Assembly, held in September 1997, in Rio de Janeiro. At the same meeting, the third working group ("Vertical Datum") was created with the objective of defining and establishing a unified vertical reference system for the continent. To accomplish this, the SIRGAS 2000 Global Positioning System (GPS) campaign was carried out from May 10 to 19, 2000. The 58 stations established during the first phase of the project were reoccupied (in order to support the computation of velocities for each station), as well as tide gauges used to classically define the national vertical networks in the past. In this campaign, the participation of North America, Central America, and Caribbean was coordinated, establishing a framework covering the whole Americas. With SIRGAS, the entire continent has an up-to-date and consistent framework, compatible with modern positioning techniques, according to the georeferencing requirements of the new millennium.

INTRODUCTION

The South American Geocentric Reference System - SIRGAS (*Sistema de Referência Geocêntrico para a América do Sul*) project was initiated at the International Conference for the Definition of a South American Geocentric Datum, convened from 4 through 7 October 1993, in Asuncion, Paraguay, by invitation of the International Association of Geodesy - IAG, the Pan-American Institute of Geography and History – PAIGH, and the United States Defense Mapping Agency - DMA (now, National Imagery and Mapping Agency - NIMA). Representatives of the

three sponsoring organizations and of almost all South American countries participated in that Conference.

The objectives established for the project were the following:

- to define a reference system for South America;
- to establish and maintain a reference network; and
- to define and establish a geocentric datum.

The goals to be achieved were:

- to reach the defined objectives in 1997, coinciding with the Scientific Assembly of the International Association of Geodesy, with the exception of maintenance which is permanent;
- to promote and coordinate the efforts of each South American country to achieve the defined objectives;
- to establish a high precision Global Positioning System (GPS) network, in accordance with the objectives of Resolution No. 2 of the 10th Meeting of the Directors of South American Geographic Institutes (DIGSA), held in La Paz, Bolivia, in 1993;
- to concentrate attention at the beginning on the Horizontal Datum; and
- to facilitate the connection of pre-existing networks.

The following definitions of the reference system and of the geocentric datum for the continent were adopted by the participants of the Asuncion Conference:

- SIRGAS reference system: IERS (International Earth Rotation Service) Terrestrial Reference Frame (ITRF) [http://lareg.ensg.ign.fr/ITRF/];
- geocentric datum: coordinate axes based on the SIRGAS reference system and parameters of the "Geodetic Reference System 1980 (GRS80)" ellipsoid [http://www.dgfi.badw.de/geodis/REFS/grs80.html].

The activities of the SIRGAS project have been designed to develop a continental reference network with a precision and accuracy compatible with modern positioning techniques, mainly those associated with GPS. Considering the proliferation of GPS utilization, it was decided that it would be, at the very least, a waste of resources to tie the new surveys to the existing geodetic structure which was based on classical survey methods (triangulation, traverse, trilateration, etc.) and for which the precision is at least ten times worse than that easily obtained with the GPS. In addition, the multiplicity of classical geodetic systems used by the South American countries made the solution of technically simple problems, such as the definition of international borders, very difficult. The adoption of the ITRF as a common reference system guarantees the

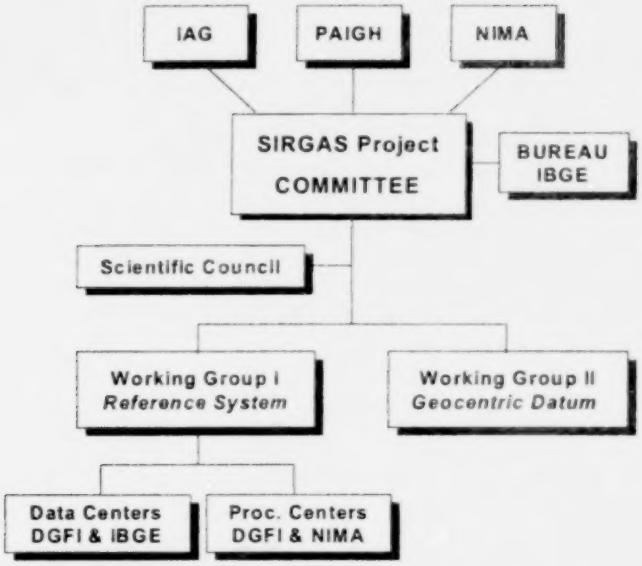

Figure 1: Organizational structure of the SIRGAS project, created during the Asuncion conference, in 1993

homogeneity of the results within the continent and allows the consistent integration of the SIRGAS network with the networks of other continents, thus contributing more and more to the development of a global geodesy.

WORKING GROUPS' ACTIVITIES

The organizational structure of the project, created during the Asuncion conference, is shown in Figure 1.

The project committee is composed of a representative from each country of the continent and one from each sponsoring organization. The committee is responsible for establishing the direction of the project and for analyzing the results obtained by the working groups. The bureau works as the committee headquarters, furnishing support to the president of the committee in accomplishing his tasks. The scientific council is composed of eminent professionals in geodesy from the international community, whose charge is to assist the committee and the working groups in their analyses and decisions.

The working group I (WG I) has been responsible for the establishment of the reference system. For this purpose, it organized a continental GPS campaign, carried out from May 26 to June 4, 1995. During this campaign, 58 principal stations and 9 eccentric ones were occupied (Figure 2), establishing one of the most accurate continental geodetic networks in the world. The accuracy of the station coordinates is estimated to be better than 2 cm. The processing of the GPS data collected during the campaign was accomplished independently by Deutsches Geodaetisches

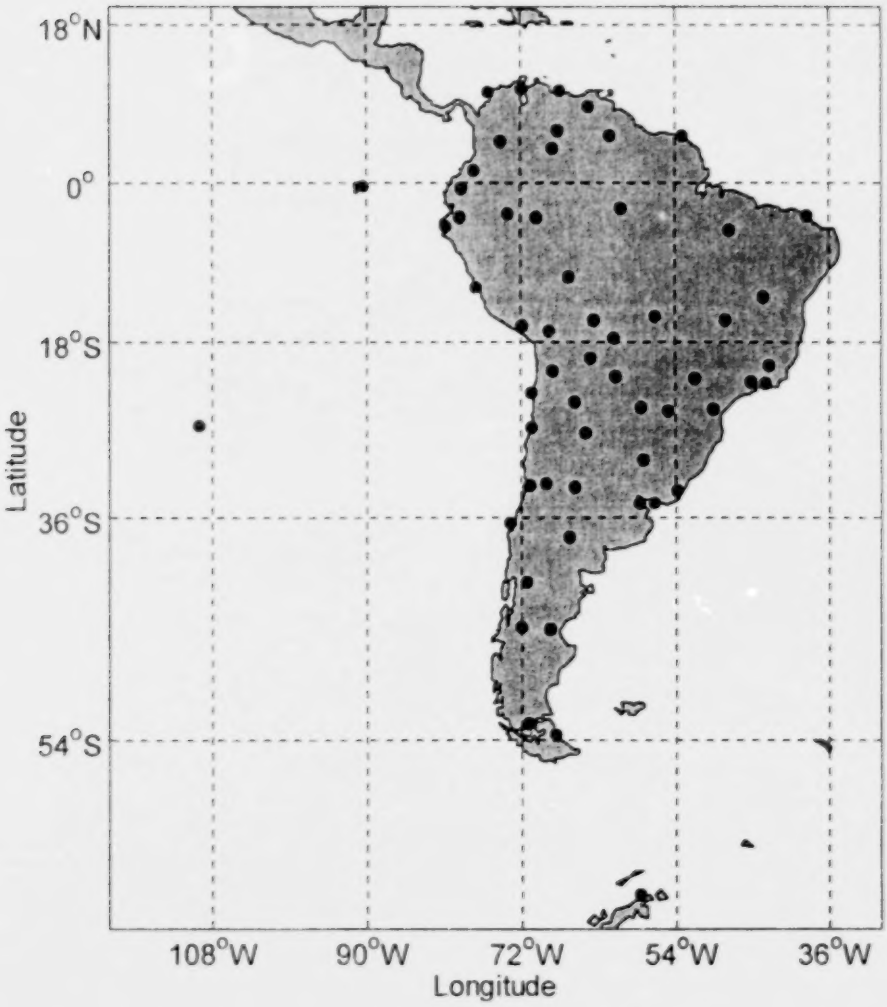

Figure 2: Principal stations occupied during the SIRGAS 95 GPS campaign (total of 58)

Forschungsinstitut (DGFI), Germany (as the IAG representative in the project) and by NIMA, USA.

Working group II "Geocentric Datum" (WG II) has been in charge of coordinating the integration of the national geodetic networks of each South American country into the SIRGAS reference frame. Each country, with support of WG II, has individually carried out such integration.

The official results for the continental reference network, as well as the status of the national geodetic networks' integration into SIRGAS, were presented during the IAG Scientific Assembly, held in September 1997, in Rio de Janeiro, as planned in the Asuncion conference. During the same event, the working group III "Vertical Datum" (WG III) was created, with the following objectives:

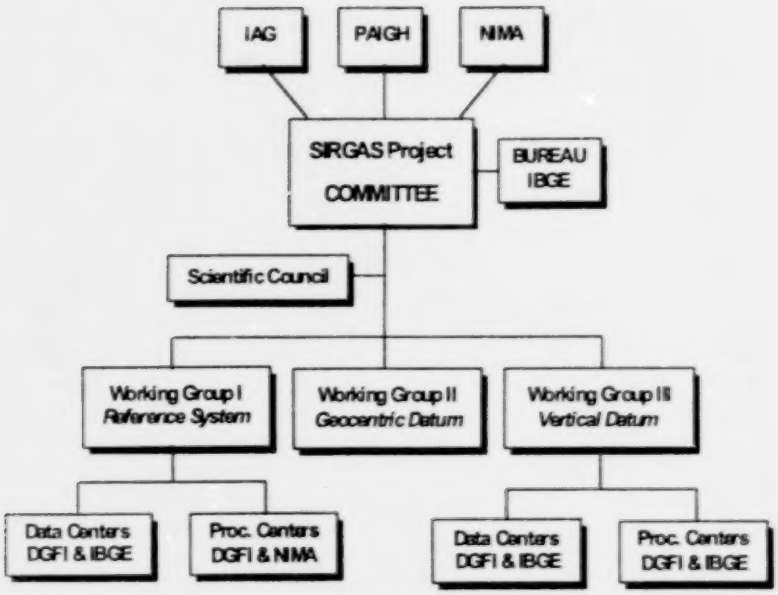

Figure 3: Organizational structure of the SIRGAS project, after establishing the WG III, during the Rio de Janeiro meeting, in 1997

- to define and establish a unified vertical reference system for the continent;
- to connect the existing altimetric networks to the new datum.

With the WG III created during the IAG meeting, the project structure changed to the one shown in Figure 3.

The working groups have organized the following meetings by the present date:

- April 20-22, 1994, Bogota, Colombia: first WG II meeting;
- October 24-28, 1994, La Plata, Argentina: first WG I meeting and second WG II one;
- August 5-9, 1996, Santiago, Chile: second WG I meeting and third WG II one;
- April 8-11, 1997, Margarita Island, Venezuela: third WG I meeting and fourth WG II one.
- August 11-13, 1998, Santiago, Chile: first WG III meeting;
- July 19-30, 1999, Birmingham, UK: fourth WG I meeting and second WG III one.

During the first WG III meeting, aspects related to the height system and the reference surface to be adopted in the continent were discussed, being decided that two types of heights will be adopted: ellipsoidal heights, referred to the SIRGAS datum, and another type based on geopotential numbers. In addition to that, it was decided to realize the vertical reference system through a set of stations with known SIRGAS coordinates, for which geodetic leveling and gravimetric information is available, and tide gauges that define the classical vertical datum in each country.

The SIRGAS 2000 GPS campaign was jointly planned by WG I and WG III and accomplished from May 10 to 19, 2000, with two objectives:

- To repeat the first GPS campaign, occurred in 1995, in order to support the computation of velocities for the SIRGAS reference network stations;
- To collect GPS data for the WG III activities.

Hence the stations established during the first phase of the project were re-occupied. Additional stations were established in tide gauges, with the objective of supporting the integration of the classical altimetric systems into the new unified one, and others set up close to international borders in order to facilitate the link between the national vertical systems. North America, Central America and Caribbean participated in this campaign, establishing a geodetic network that covers the whole American continent from north to south. More than 180 stations were occupied during the campaign. The majority of collected data has already been sent to the data centers, at DGFI and IBGE. The corresponding stations are shown in Figure 4. Additional ten stations from the US CORS (Continuously Operating Reference Stations) network [http://www.ngs.noaa.gov/CORS/] may be considered to improve station distribution in USA.

The next activities include an independent campaign processing by DGFI and IBGE. The preliminary results are going to be presented at the IAG International Symposium on Vertical Reference Systems, to be held from February 20 to 23, 2001, in Cartagena, Colombia. (more information can be found at the event's homepage: http://www.igac.gov.co/veres.html or http://www.dgfi.badw.de/veres/veres.html).

SIRGAS PUBLICATIONS

All project publications are issued by IBGE, as the central bureau. They are published in two versions: Portuguese/Spanish and English. The following ones were published by now:

- **Newsletters**. They describe the project activities as long as they are being carried out.
  - ✓ #1: Sep. 1994
  - ✓ #2: Dec. 1994
  - ✓ #3: Dec. 1995
  - ✓ #4: Dec. 1996
  - ✓ #5: Feb. 1998

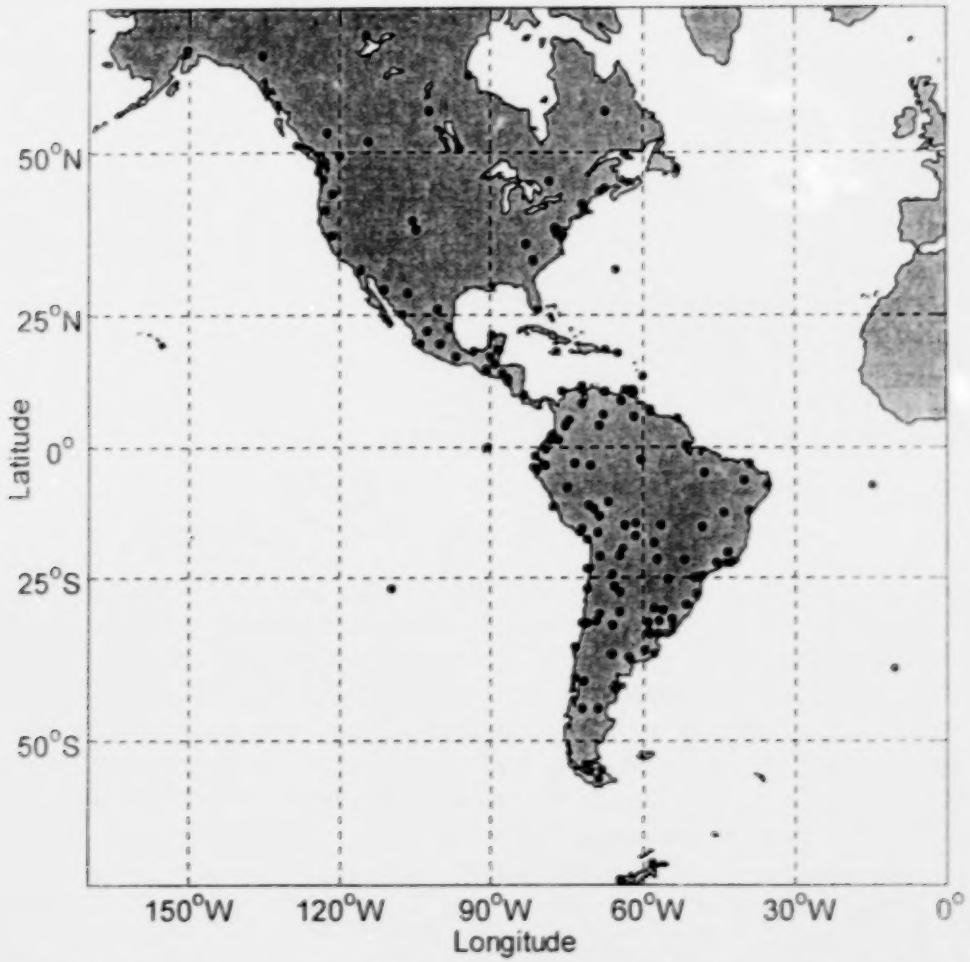

Figure 4: Stations occupied during the SIRGAS 2000 GPS campaign (total of 178 by November 2000). Additional ten stations from the US CORS network may be considered to improve station distribution in USA

- **Final Report, Working Groups I and II**. It contains a complete description of the project, details about the SIRGAS 95 GPS campaign processing carried out by DGFI and NIMA, including the official results, and reports from South-American countries with respect to the national geodetic networks integration into SIRGAS.

  ✓ Sep. 1997, distributed during the IAG Scientific Assembly, in Rio de Janeiro.

All publications are available for download at the SIRGAS homepage, located at the following address: http://www.ibge.gov.br/geografia/seminario/sirgas/principal.htm.

CONCLUSION

The SIRGAS project encompasses all activities necessary to establish a modern geodetic framework in the continent, compatible with the most accurate positioning techniques available nowadays. The adoption of a geocentric system based on ITRF guarantees that SIRGAS will always continue to be up-to-date, according to the georeferencing requirements of the new millennium.

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The project has been extremely successful. This was only possible due to the high level of cooperation obtained from each participant, including the South American countries, the sponsoring organizations and the scientific consultants, representing more than 30 institutions from the Americas and Europe, all working towards the development of the South American continent. This cooperation was again observed during the SIRGAS 2000 GPS campaign, with the additional participation of several institutions from North America, Central America and Caribbean.